XMC-6280

10-Gigabit Ethernet

XMC Module

USER'S MANUAL

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IMPORTANT SAFETY CONSIDERATIONS

You must consider the possible negative effects of power, wiring, component, sensor, or software failure in the design of any type of control or monitoring system. This is very important where property loss or human life is involved. It is important that you perform satisfactory overall system design and it is agreed between you and Acromag, that this is your responsibility.

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RELATED PUBLICATIONS

The following manuals and part specifications provide the necessary information for in depth understanding of the XMC-6280 board.

Chelsio T4/T5 Unified Wire for Linux Installation and User's Guide	**http://service.chelsio.com**
Chelsio T4/T5 Unified Wire for Windows Installation and User's Guide	**http://service.chelsio.com**

1.0 GENERAL INFORMATION

The XMC-6280 is a quad port 10 Gigabit Ethernet Unified Wire adapter XMC module, optimized for cloud computing, HPC, virtualization, storage, and other data center applications.

The heart of the XMC-6280 is Chelsio's Terminator 4 (T4) ASIC. The T4 ASIC provides the highest 10GbE performance available and dramatically lowers host-system CPU communications overhead with on-board hardware that off-loads TCP/IP, iSCSI, FCoE and iWARP RDMA processing from its host system. The XMC-6280 frees up host CPU cycles for useful applications. As a result, the system achieves increased bandwidth, lower latency, and lower power.

The XMC-6280 is an XMC module with eight high speed serial lanes allocated to the XMC P15 connector. These lanes are used as an 8-lane PCIe Gen 2 interface.

Four high speed Ethernet interfaces are routed from the ASIC to four SFP+ (Small Form-factor Pluggable) module connectors. Each SFP+ port is capable of 10Gb/s full-duplex operation for both fiber optic and copper connections.

The XMC-6280 has a 256kb EEPROM, 32Mb of serial flash memory, and 5Gb DDR3 SDRAM. The serial flash memory contains the ASIC's internal microprocessor firmware code. The EEPROM contains hardware and PCIe configuration information. On power up, the ASIC will copy the firmware from the flash into DRAM. The 5Gb of DDR3 will contain the data buffers and connection information to support up to 32K offloaded connections.

Ordering Information

The following table lists the orderable model and its description. XMC-6280-LF is air-cooled with an operating temperature of -20°C to +70°C.

Table 1.1: *The XMC-6280 board is only available in a lead free version.*

MODEL	Description
XMC-6280-LF	Lead Free, RoHS compliant

Key Features

An XMC-6280 block diagram, found at the end of this manual, illustrates the key features listed below.

- **Terminator 4 ASIC –** A high performance purpose-built protocol processor with a single processor data-flow pipelined architecture that delivers up to one million connections and simultaneously supports wire-speed, fully offloaded TCP/IP, UDP, FCoE, iSCSI and iWARP RDMA on a single unified wire.
- **DDR3 SDRAM –** Provides 64 Meg x 72-bit DDR3 SDRAM. The SDRAM is linked to the ASIC device for the storage of the ASIC's internal microprocessor firmware, data buffers and connection information to support up to 32k offloaded connections.
- **P15 High Speed Interface –** Eight high speed serial lanes are allocated to the XMC P15 connector. These lanes are used as an 8 lane PCIe Gen 2 interface to the T4 ASIC.
- **SFP+ High Speed Interface –** The four high speed serial interfaces are routed from the ASIC to four SFP+ (Small Form-factor Pluggable) module connectors. SFP+ provides a full-duplex 10GbE interface.

Applications

- **Data-Center Networking**
  - Scale up servers and network-attached storage (NAS) systems
  - Link servers in multiple facilities to synchronize data centers
  - Consolidate local area networks (LAN), storage area networks (SAN) and cluster networks
- **Cloud Computing**
  - Virtualization features to maximize cloud scaling and utilization

  - Runs InfiniBand, Fibre Channel apps unmodified on Ethernet
  - Cloud ready functional and management features
  - Quality of Service (QoS) and Traffic management

- **Networked Storage**
  - Enable high performance NAS systems and Ethernet-based IP SANs
  - Develop shared-storage systems providing both file- and block-level services

- **High Performance Computing**
  - Very low latency Ethernet
  - Increase cluster fabric bandwidth
  - Deploy Ethernet-only networking for cluster fabric, LAN and SAN

Hardware Requirements

The XMC-6280 supports architectures with PCIe (x4, x8) gen 2 slots. Note that running a 10Gb adapter on a PCIe x4 slot is not recommended as performance will be significantly reduced by the limitations of PCIe. PCIe Gen 2 is also backwards compatible with Gen 1; however, the use of Gen 1 will also result in significantly reduced performance.

Software Requirements

Supported operating systems and functions vary by driver release. The XMC-6280 has been developed to run on 64-bit Linux systems as well as 64-bit Windows systems. To know more about the complete list of operating systems supported by each driver, please refer to the driver's README information available from Chelsio's website at http://service.chelsio.com.

MAC Addresses

A MAC ID has been assigned to each of the four SFP+ ports on the XMC-6280. The base address has been listed on a label on the bottom side of the board. The following MAC addresses are assigned in increments of 8. For example, if the base MAC ID is 00:01:C3:00:7F:5A, the following MAC IDs are 00:01:C3:00:7F:62, 00:01:C3:00:7F:6A and 00:01:C3:00:7F:72.

2.0 PREPARATION FOR USE

Unpacking and Inspecting

CAUTION
SENSITIVE ELECTRONIC DEVICES
DO NOT SHIP OR STORE NEAR STRONG ELECTROSTATIC, ELECTROMAGNETIC, MAGNETIC OR RADIOACTIVE FIELDS

WARNING: This board utilizes static sensitive components and should only be handled at a static-safe workstation.

Upon receipt of this product, inspect the shipping carton for evidence of mishandling during transit. If the shipping carton is badly damaged or water stained, request that the carrier's agent be present when the carton is opened. If the carrier's agent is absent when the carton is opened and the contents of the carton are damaged, keep the carton and packing material for the agent's inspection.

For repairs to a product damaged in shipment, refer to the Acromag Service Policy to obtain return instructions. It is suggested that salvageable shipping cartons and packing material be saved for future use in the event the product must be shipped.

This board is physically protected with packing material and electrically protected with an anti-static bag during shipment. However, it is recommended that the board be visually inspected for evidence of mishandling prior to applying power.

Card Cage Considerations

Refer to the specifications section for loading and power requirements. Be sure that the system power supplies are able to accommodate the power requirements of the system boards, plus the installed Acromag board, within the voltage tolerances specified.

In an air cooled assembly, adequate air circulation must be provided to prevent a temperature rise above the maximum operating temperature and to prolong the life of the electronics. If the installation is in an industrial environment and the board is exposed to environmental air, careful consideration should be given to air-filtering.

In a conduction cooled assembly, adequate thermo conduction must be provided to prevent a temperature rise above the maximum operating temperature.

Board Installation

Remove power from the system before installing board, cables, termination panels, and field wiring.

P15 Primary XMC Connector

The P15 primary XMC connector connects directly to the T4 ASIC via eight lanes of Gen 2 PCI Express. The connector pin out, complies with the ANSI/VITA 42.3-2006 pin definitions. Note that the XMC-6280 does not support wakeup functionality and does not have a 3.3V aux line.

This XMC connector is a 114-pin Samtec ASP-103614-05 connector. The connector complies with the ANSI/VITA 42.3-2006.

SFP+ Module Connector

Table 2.1: *Board Front SFP+ Module Contact definition.*

Pin	Symbol	Pin Description
1	VeeT	Module Transmitter Ground
2	Tx_Fault	Module Transmitter Fault
3	Tx_Disable	Transmitter Disable
4	SDA	2-wire Serial Interface Data Line
5	SCL	2-wire Serial Interface Clock
6	Mod_ABS	Module Absent
7	RS0	Rate Select
8	Rx_LOS	Receive Loss of Signal Indication
9	VeeR	Module Receiver Ground
10	VeeR	Module Receiver Ground
11	VeeR	Module Receiver Ground
12	RD-	Receiver Inverted Data Output
13	RD+	Receiver Non-Inverted Data Output
14	VeeR	Module Receiver Ground
15	VccR	Module Receiver 3.3 V Supply
16	VccT	Module Transmitter 3.3 V Supply
17	VeeT	Module Transmitter Ground
18	TD+	Transmitter Non-Inverted Data Input
19	TD-	Transmitter Inverted Data Input
20	VeeT	Module Transmitter Ground

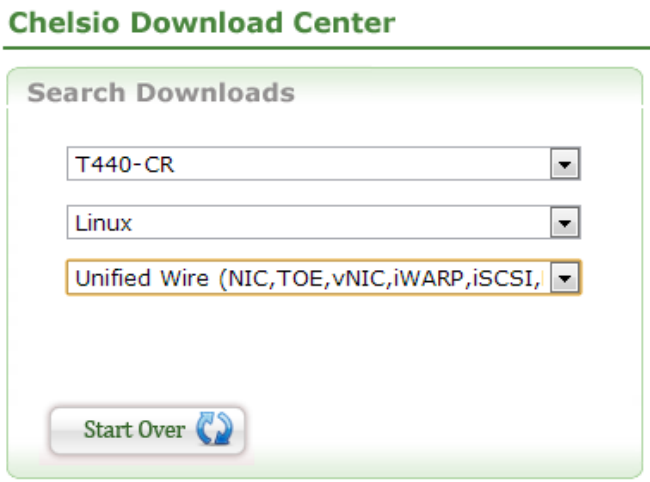
Non-Isolation Considerations

The board is non-isolated, since there is electrical continuity between the logic and field I/O grounds. As such, the field I/O connections are not isolated from the system. Care should be taken in designing installations without isolation to avoid noise pickup and ground loops caused by multiple ground connections.

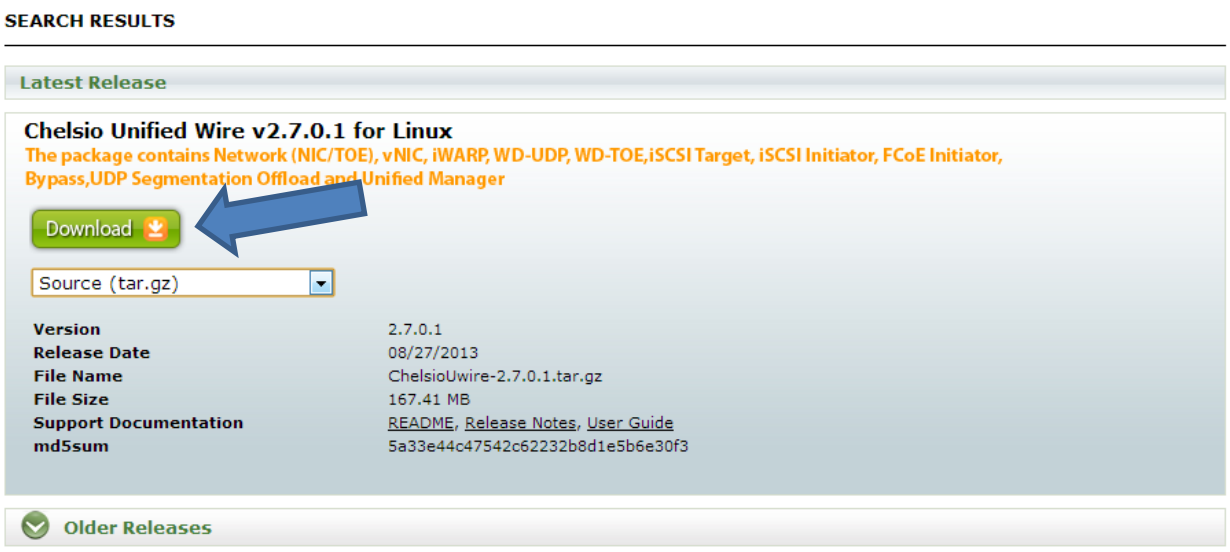
3.0 SOFTWARE/DRIVER INFORMATION

Software/Driver Download from Linux Source Tarball

1. Go to http://service.chelsio.com and search the downloads as shown below.



2. In the **SEARCH RESULTS** choose the source tarball and click **Download**.


SEARCH RESULTS
Latest Release
Chelsio Unified Wire v2.7.0.1 for Linux
The package contains Network (NIC/TOE), vNIC, iWARP, WD-UDP, WD-TOE,iSCSI Target, iSCSI Initiator, FCoE Initiator, Bypass,UDP Segmentation Offload and Unified Manager
Download
Source (tar.gz)
Version 2.7.0.1
Release Date 08/27/2013
File Name ChelsioUwire-2.7.0.1.tar.gz
File Size 167.41 MB
Support Documentation README, Release Notes, User Guide
md5sum 5a33e44c47542c62232b8d1e5b6e30f3
Older Releases

3. Read and accept the Chelsio End User License Agreement.

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June 1, 2006
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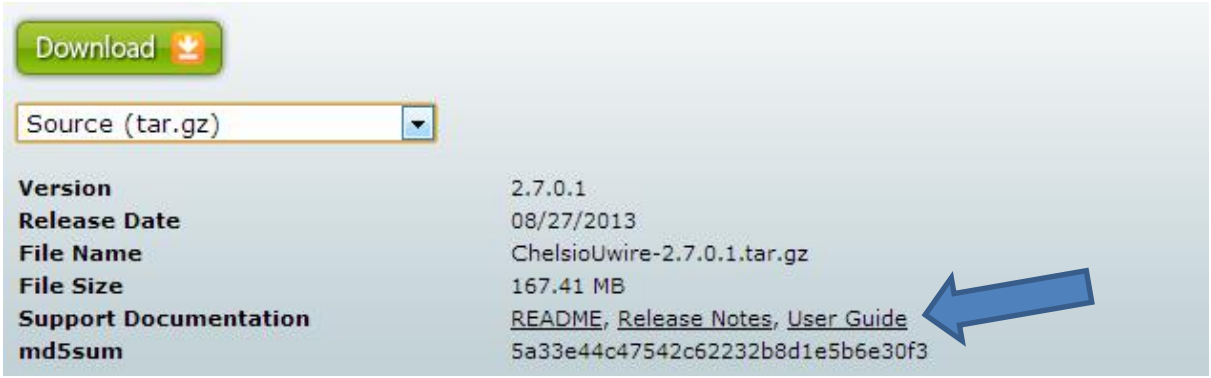
2. Restrictions. This license granted hereunder does not constitute a sale of the Software or any copy thereof.

Accept Cancel Print Back to Downloads

4. Download the Chelsio support documentation including the README, Release Notes and User Guide. **Refer to the User Guide for information on how to properly install and use the Chelsio drivers.**



Software/Driver Download for Windows Operating Systems

1. Go to http://service.chelsio.com/downloads/Microsoft/ to download the latest Windows Unified Wire driver. Refer to the README file for information on supported operating systems and functionality.

Microsoft
Windows Unified Wire
Chelsio Unified Wire InstallShield v5.0.0.35 - WHQL Certified
Package Name ChelsioUwire-5.0.0.35.exe
Package Type exe
Release Date : 11/06/2014
Version 5.0.0.35
File Size : 49 MB
md5sum : 02af917 226d4a0359a76deaadd
Supported Docs : README, Release Notes, User Guide
Note: The InstallShield installs NDIS function driver (v5.3.21.0), UM (v2.4.62) and UM for Win PE (v2.4.62). The driver installs T5 firmware (v1.12.25.0), T4 firmware (v1.12.25.0) and supports NIC,NDK and NVGRE offload functionalities.
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Chelsio Unified Wire Driver Package v5.0.0.35 - WHQL Certified
Package Name ChelsioUwire-5.0.0.35.zip
Package Type zip
Release Date : 11/06/2014
Version 5.0.0.35
File Size : 33 MB
md5sum : 9404ad8ddf344004c2504e415c85c3e1
Supported Docs : README, Release Notes, User Guide
Note: The driver package contains NDIS function driver (v5.3.21.0), UM (v2.4.62) and UM for Win PE (v2.4.62). The driver installs T5 firmware (v1.12.25.0), T4 firmware (v1.12.25.0) and supports NIC,NDK and NVGRE Offload functionalities.
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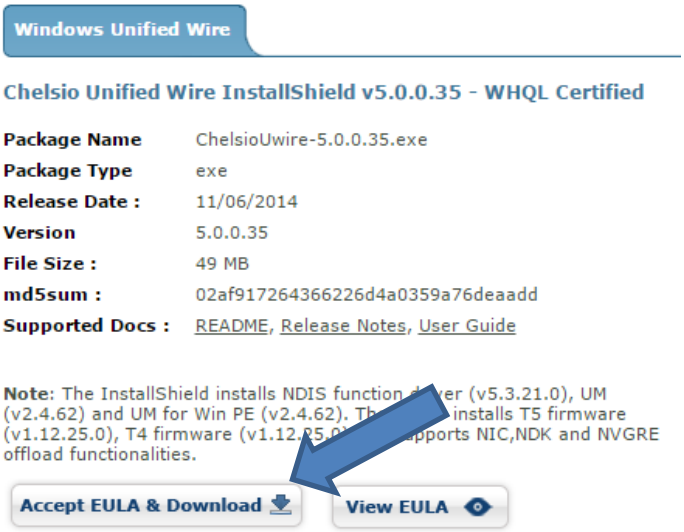
2. View the EULA, then click on **Accept EULA & Download** to download the .exe file.


Windows Unified Wire
Chelsio Unified Wire InstallShield v5.0.0.35 - WHQL Certified
Package Name ChelsioUwire-5.0.0.35.exe
Package Type exe
Release Date : 11/06/2014
Version 5.0.0.35
File Size : 49 MB
md5sum : 02af917264366226d4a0359a76deaadd
Supported Docs : README, Release Notes, User Guide
Note: The InstallShield installs NDIS function driver (v5.3.21.0), UM (v2.4.62) and UM for Win PE (v2.4.62). installs T5 firmware (v1.12.25.0), T4 firmware (v1.12.25.0) supports NIC,NDK and NVGRE offload functionalities.
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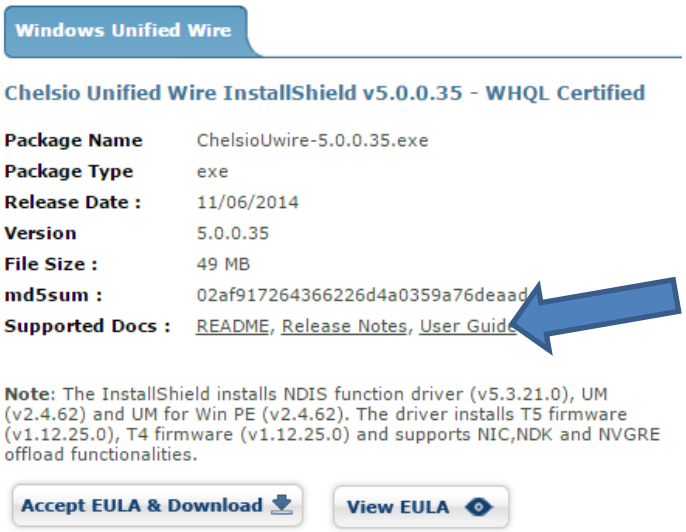
3. Run the **ChelsioUwire-x.x.x.xx.exe** installer application. Refer to the User Guide for information on how to properly install and use the Chelsio drivers.


Windows Unified Wire
Chelsio Unified Wire InstallShield v5.0.0.35 - WHQL Certified
Package Name ChelsioUwire-5.0.0.35.exe
Package Type exe
Release Date : 11/06/2014
Version 5.0.0.35
File Size : 49 MB
md5sum : 02af917264366226d4a0359a76deaad
Supported Docs : README, Release Notes, User Guide
Note: The InstallShield installs NDIS function driver (v5.3.21.0), UM (v2.4.62) and UM for Win PE (v2.4.62). The driver installs T5 firmware (v1.12.25.0), T4 firmware (v1.12.25.0) and supports NIC,NDK and NVGRE offload functionalities.
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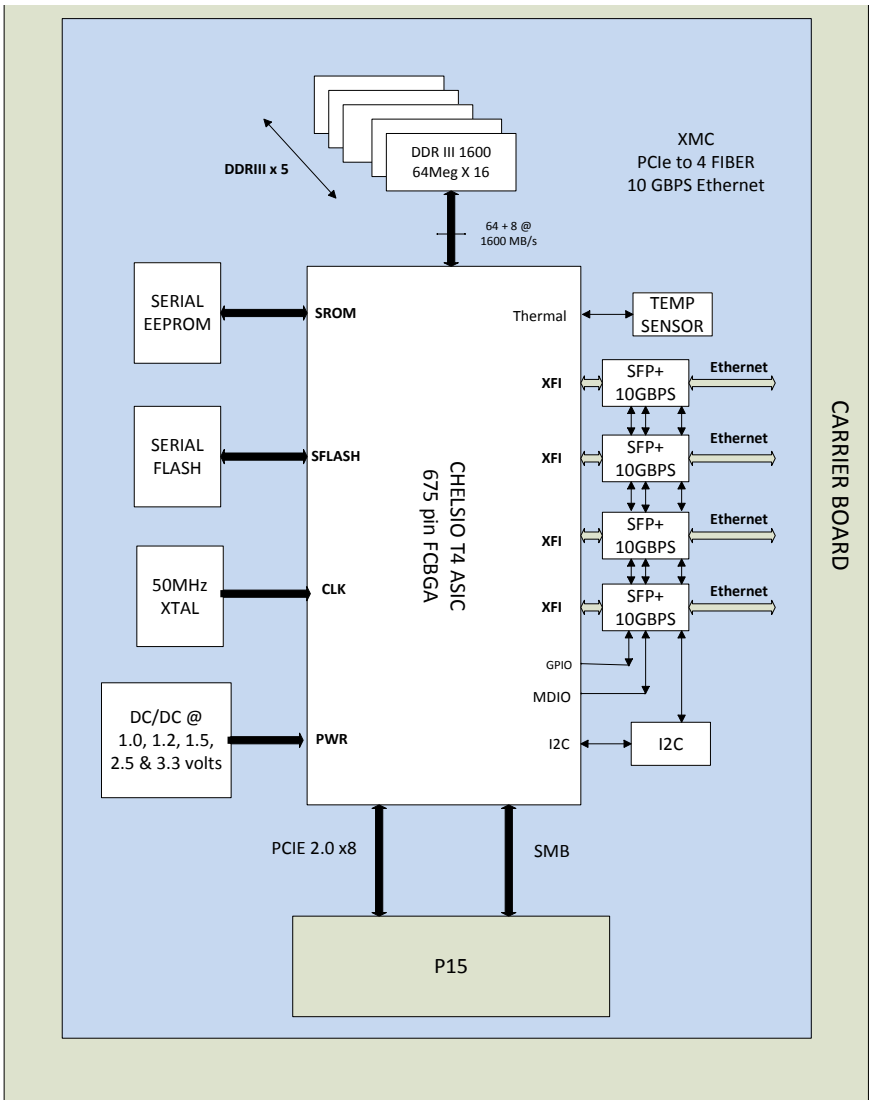
4.0 THEORY OF OPERATION

This section contains information regarding the design of the board. A description of the basic functionality of the circuitry used on the board is also provided. Refer to the XMC-6280 Block Diagram, shown below, as you review this material.

Figure 4.1: XMC-6280 Block Diagram



PCIE INTERFACE LOGIC

The XMC-6280 host interface is through PCI Express 2.0 which provides a 5Gbps interface to the carrier/CPU board. The PCIe interface supports 8 physical functions (PF). SR-IOV is supported on 4 PF with 128 virtual functions (VF). It supports x1, x2, x4 and x8 link widths. Maximum payload sizes and memory read request sizes of 128B to 2KB are supported, with up to 128 outstanding PCIe reads.

SFP+ Module Connectors

The board contains four small form-factor pluggable plus (SFP+) connectors and cage assemblies that accept SFP+ modules as well as SFP modules. The SFP+ interfaces are wired directly to the T4 ASICs integrated full-duplex Ethernet MACs. The appropriate SFP rate will be configured automatically by the T4 firmware. Firmware will also be in control of the other SFP signals including Tx_Fault, Tx_Disable, Rx_LOS and Mod_ABS.

DDR3

There is a 64 Meg x 72-bit of DDR3 memory onboard for the purpose of storing connection states and buffers for up to 32K offloaded connections. Five DDR3 memory devices are used to form a 72-bit data bus. Each of the devices are 64 Meg x 16 bit (1Gb) in size.

Clock Generation

There is one onboard 50MHz XTAL providing the core clock to the T4 ASIC. This XTAL is all that is needed in order for the ASIC to internally produce the necessary clocks needed for operation.

Serial EEPROM

There is a 256Kb Atmel SPI Serial EEPROM which contains all the hardware configuration including things like pll multipliers and PCIe information. It also contains information on how to configure the firmware for the T4 ASIC including things like how to set up the DDR3 and the number of ports available on the card.

This Serial EEPROM is not intended to be reprogrammed by the customer, and doing so could cause a device failure.

Serial Flash

The 32 Mb serial flash contains all the ASIC's internal microprocessor firmware code. Once the ASIC and microprocessor boots itself, the EEPROM is read first to get configuration information. Then the ASIC copies the firmware from the flash to DDR3 memory and runs everything from there.

This Serial EEPROM is not intended to be reprogrammed by the customer, and doing so could cause a failure in the device. The driver will auto-load the firmware if an update is required. The kernel must be configured to enable userspace firmware loading support:

Device Drivers → Generic Driver Options → Userspace firmware loading support

Temperature Sensor

A Texas Instruments TMP421 temperature sensor is connected to the thermal pins of the Terminator 4 ASIC to monitor the junction temperature of the ASIC and also the local temperature of the temperature senor. The ASIC has been designed to shut down at junction temperatures above 115 degrees Celsius. This is in an attempt to save the chip from being damaged and is not a guarantee that it will not be damaged.

Power System Devices

The power to the XMC-6280 is taken from the XMC P15 connector VPWR_5/12 pins. The VPWR_5/12 power is the V in voltage to the three LTM4602 devices U16, U17 and U18 and also to the LTM4601 devices U19 and U21. The LTM4602 devices output +2.5V, +1.5V and +1.2V while the LTM4601 devices output +1.0V. The +1.5V supply is input to the TPS51200 device U15 to output +0.75V for DDR3 termination.

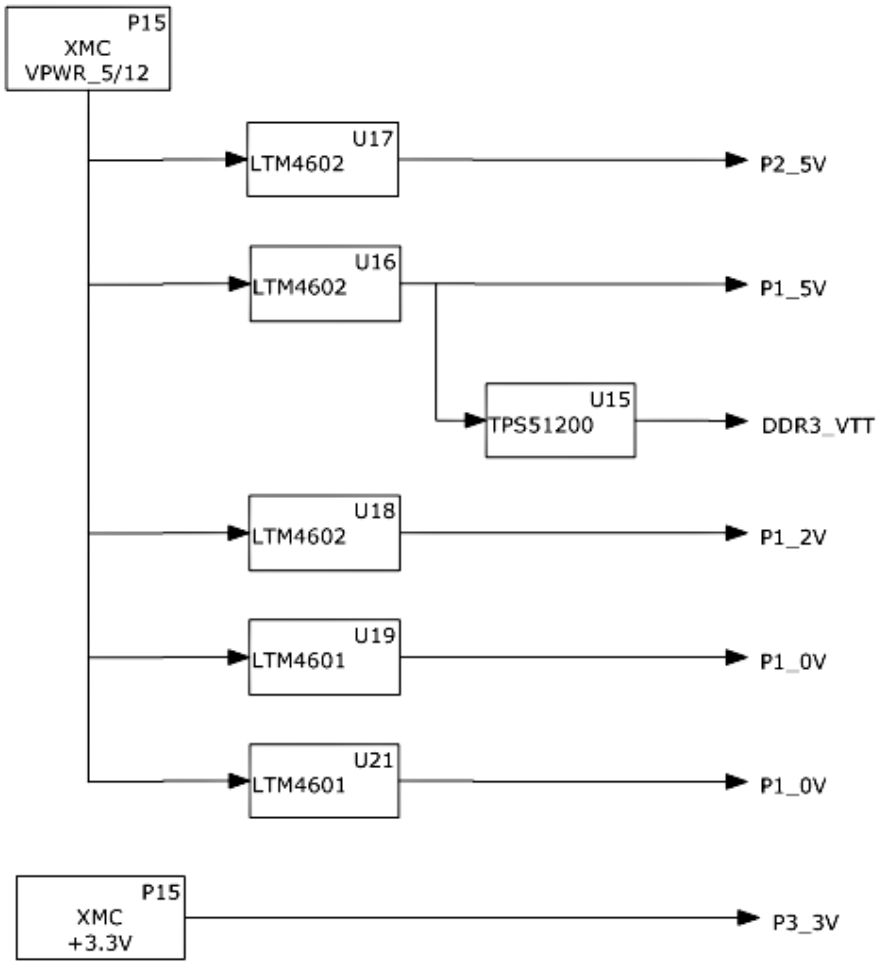


Figure 4.2: Power Distribution

Device	Reference Designator	Description	Power Rail Name	Power Rail Current
LTM4602	U17	ASIC, PCIe, Ethernet	P2_5V	6.0A
LTM4602	U16	ASIC, DDR3, PCIe, Ethernet	P1_5V	6.0A
TPS51200	U15	DDR3 Termination	DDR3_VTT	+/-2A
LTM4602	U18	ASIC, Ethernet	P1_2V	6.0A
LTM4601	U19	ASIC, PCIe,	P1_0V	12A
LTM4601	U21	ASIC, PCIe	P1_0V	12A

Figure 4.3: Power System

5.0 SERVICE AND REPAIR

Surface-Mounted Technology (SMT) boards are generally difficult to repair. It is highly recommended that a non-functioning board be returned to Acromag for repair. The board can be easily damaged unless special SMT repair and service tools are used. Further, Acromag has automated test equipment that thoroughly checks the performance of each board. When a board is first produced and when any repair is made, it is tested before shipment.

Service and Repair Assistance

Please refer to Acromag's Service Policy Bulletin or contact Acromag for complete details on how to obtain parts and repair.

Preliminary Service Procedure

CAUTION: **POWER MUST BE TURNED OFF BEFORE REMOVING OR INSERTING BOARDS**

Before beginning repair, be sure that all of the procedures in the "Preparation for Use" section have been followed. Also, refer to the documentation of your board to verify that it is correctly configured. Replacement of the board with one that is known to work correctly is a good technique to isolate a faulty board.

Where to Get Help

If you continue to have problems, your next step should be to visit the Acromag worldwide web site at http://www.acromag.com. Our web site contains the most up-to-date product and software information.

Acromag's application engineers can also be contacted directly for technical assistance via email, telephone, or FAX through the contact information listed at the bottom of this page. When needed, complete repair services are also available.

6.0 SPECIFICATIONS

PHYSICAL

Height	13.5 mm (0.531 in)
Stacking Height	10.0 mm (0.394 in)
Depth	149.0 mm (5.866 in)
Width	74.0 mm (2.913 in)
Board Thickness	1.57 mm (0.062 in)
Unit Weight:	4.9144oz (139.32g)

POWER REQUIREMENTS

Power will vary dependent on the application.

3.3 VDC (±5%)	Typical 50 mA	Max. 100 mA
+12/5 VDC (±5%)	Typical 1 A	Max. 1.5 A
-12 VDC (±5%)	0mA	

On Board 1.0V Power to T4 ASIC	**Current Rating** (available for the T4 ASIC)
1.0V (±5%)	12A typical 24A maximum

ENVIRONMENTAL

Operating Temperature

Model	*Operating Temperature*
XMC-6280-LF	***-20℃ to 70℃***

Relative Humidity: 5-95% Non-Condensing.

Storage Temperature: -55°C to 100°C.

Non-Isolated: PCIe bus and field commons have a direct electrical connection.

Radiated Field Immunity (RFI): Complies with IEC 61000-4-3 with no register upsets.

Conducted R F Immunity (CRFI): Complies with IEC 61000-4-6 with no register upsets.

Surge Immunity: Not required for signal I/O per IEC 61000-4-5.

Electric Fast Transient (EFT) Immunity: Complies with IEC 61000-4-4 Level 3 (1.0KV at field I/O terminals).

Electrostatic Discharge (ESD) Immunity: Complies with EN61000-4-2 Level 3 (8KV enclosure port air discharge) Level 2 (4KV enclosure port contact discharge).

Radiated Emissions: Meets or exceeds European Norm 61000-6-3:2007 for class A equipment. Shielded cable with I/O connections in shielded enclosure is required to meet compliance.

Terminator 4 ASIC (U1)

The Chelsio fourth generation Terminator 4 ASIC is a 27x27mm 675-pin FCBGA package with a 8-lane PCIe Gen2 interface to the server and four 1GbE/10GbE MACs on the network side.

P15 XMC Connector

114 pin Samtec ASP-103614-05 connector complies with ANSI/VITA 42.3-2006

P15 is the primary XMC connector

8 Gigabit differential pairs are provided for use as 8 lane PCIe Gen 2.0.

System Management (XMC provides hardware definition information read by the external controller using IPMI commands and I2C serial bus transactions.)

3.3V power (4 pins at 1A/pin)

Variable power (5V or 12V) (8 pins at 1A/pin)

SFP+ Connectors

20 pin TE Connectivity 1888247-1 or equivalent connector complies with SFF-8083

SFP+ transceiver signals routed directly to the T4 ASIC are capable of SFP+ maximum data rate of 10 Gigabit/sec.

Board Crystal

Board Crystal: 50MHz (U22)

Frequency Stability: ± 0.00500% or 50ppm

DDR3 Memory

64 Meg x 16-bit Micron Device MT41J64M16JT-125:G uses a double data rate architecture.

Five MT41J64M16JT-125:G memory devices (U8, U9, U10, U11 and U14) are used to form a 72-bit data bus to the T4 ASIC.

The DDR3 is used to store the T4 microprocessor firmware and also for data buffers and connection information when offload is enabled.

256Kb EEPROM

256Kb (32,768 x 8) Atmel SPI Serial EEPROM contains hardware configuration and PCIe configuration information. It also contains the T4 ASIC firmware configuration data.

32Mb Flash

32Mb (4Mb x 8) Micron M25P32 Serial Flash contains the T4's internal microprocessor firmware code.

Temperature Sensor

A Texas Instruments **TMP421** is supplied as a way to monitor the temperature of the ASIC and is connected to the thermal pins of the Chelsio T4 ASIC.

PCIe Bus Interface

XMC Compatibility: Conforms to PCI Express Base Specification v2.0, and XMC Specification, P1386.1

ANSI/VITA 42.0: Complies with XMC module mechanicals and connectors

ANSI/VITA 42.3: XMC module with PCI Express Interface

XMC-6280 Block Diagram

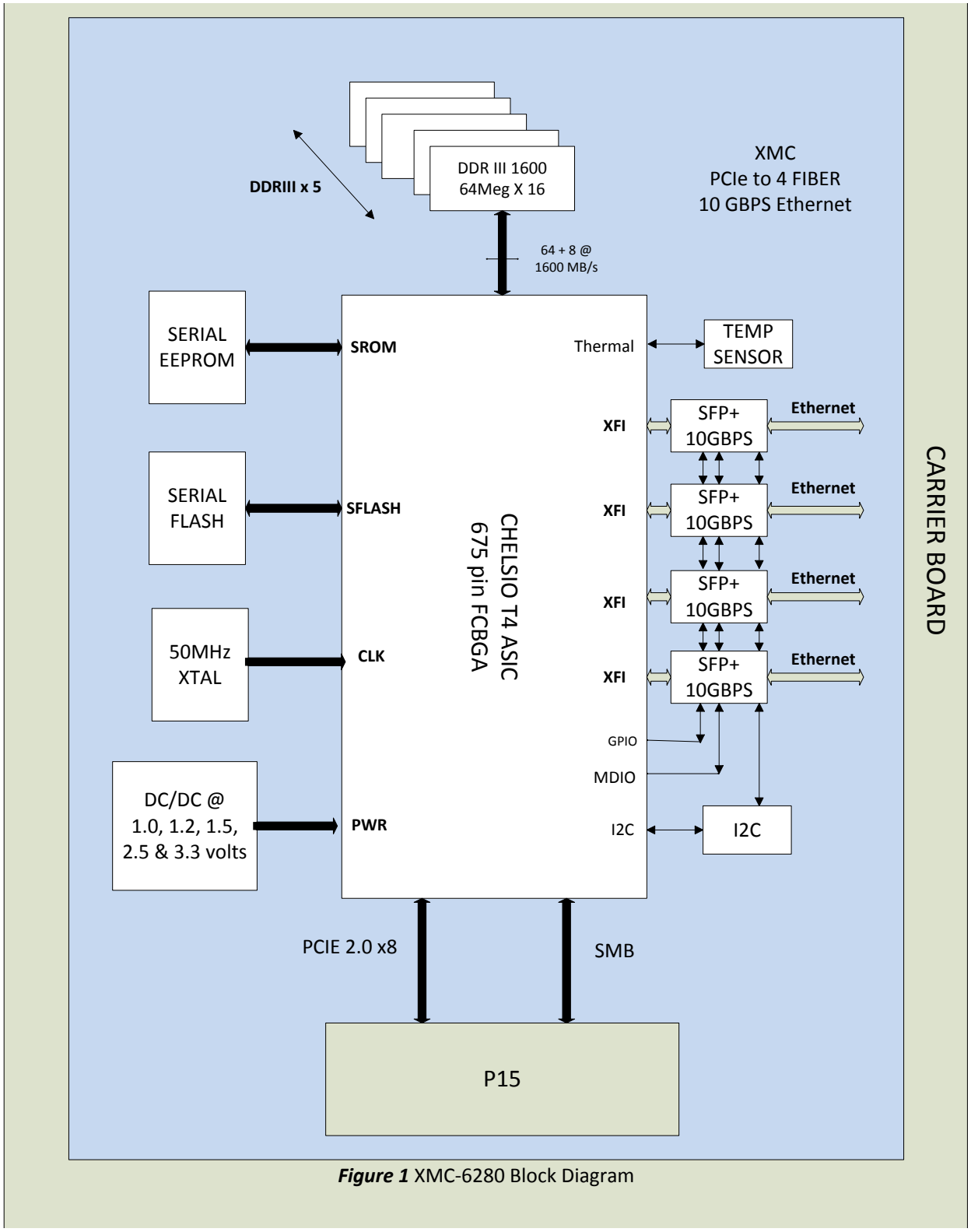


Figure 1 XMC-6280 Block Diagram

Certificate of Volatility

<table>
<tr><th colspan="5">Certificate of Volatility</th></tr>
<tr><td>Acromag Model
XMC-6280-LF</td><td colspan="4">Manufacturer:
Acromag, Inc.
30765 Wixom Rd
Wixom, MI 48393</td></tr>
<tr><th colspan="5">Volatile Memory</th></tr>
<tr><td colspan="5">Does this product contain Volatile memory (i.e. Memory of whose contents are lost when power is removed)
■ Yes □ No</td></tr>
<tr><td>Type (SRAM, SDRAM, etc.)
SDRAM</td><td>Size:
64 Meg x
72-bit</td><td>User Modifiable
■ Yes
□ No</td><td>Function:
Data storage for ASIC</td><td>Process to Sanitize:
Power Down</td></tr>
<tr><th colspan="5">Non-Volatile Memory</th></tr>
<tr><td colspan="5">Does this product contain Non-Volatile memory (i.e. Memory of whose contents is retained when power is removed)
■ Yes □ No</td></tr>
<tr><td>Type(EEPROM, Flash, etc.)
Flash</td><td>Size:
32Mbit</td><td>User Modifiable
□ Yes
■ No</td><td>Function:
Storage of ASIC Firmware</td><td>Process to Sanitize:
Not applicable</td></tr>
<tr><td>Type(EEPROM, Flash, etc.)
EEPROM</td><td>Size:
246Kbit</td><td>User Modifiable
■ Yes
□ No</td><td>Function:
Storage of PCIe, hardware and ASIC configuration data</td><td>Process to Sanitize:
Clear EEPROM memory by writing zeros to all sectors of the EEPROM</td></tr>
<tr><th colspan="5">Acromag Representative</th></tr>
<tr><td>Name:
Joseph Primeau</td><td>Title:
Dir. of Sales and Marketing</td><td>Email:
jprimeau@acromag.com</td><td>Office Phone:
248-295-0823</td><td>Office Fax:
248-624-9234</td></tr>
</table>

Revision History

Release Date	Version	EGR/DOC	Description of Revision
5-DEC-13	A	EZ/EZ	Initial Acromag release.
1-MAY-14	B	EZ/EZ	Added power requirements, Theory of Operation, temperature sensor and MAC address information. Revised Environmental conditions involving immunities and emissions.
2-Oct-15	C	CAB/MJO	Remove Leaded Option for RoHS compliance.